



BLUE LOGIC

## OPERATION AND MAINTENANCE MANUAL

**DOCUMENT TITLE:** Operation and Maintenance Manual  
**PROJECT TITLE:** 3.5 Ø100+-Valvestab  
**PROJECT:** 600135  
**PACKAGE DESCRIPTION:** 1" Valve Stab System  
**DOCUMENT NUMBER:** 600135-TD-0001  
**REV:** 01  
**NUMBER OF PAGES:** 31  
  
**DATE:** 04.09.2012  
**CLIENT:**  
**CLIENT PO:**  
**CLIENT DOC NO.:**  
**CONTACT PERSON:**

## TECHNICAL DOCUMENT

### OBJECTIVE

The objective of this document is to present a comprehensive Operation and Maintenance manual for the Blue Logic designed 1" Valve Stab™ System with outer Stab diameter of Ø100mm. The System, includes both male and female parts with varying number of hydraulic ports. All relevant aspects with regards to safe and correct use, installation, operation, maintenance and storage are covered.

### ABSTRACT

The Blue Logic Valve Stab™ System combines the functionality and quality of a ball valve and a pressure balanced Hot Stab thus forming a reliable field proven leakage free high flow ROV Stab Connector System. The Valve Stab™ System Program comprises the following main components:

- Male Valve Stab™
- Female Valve Stab™ Receptacle
- Fail Safe Close/Open System
- Cavity flushing system
- Protection Stab
- Parking receptacle

For detailed information with regards to available variants and updated overview of the 1" Valve Stab Program, please contact Blue Logic.

In general, the Valve Stab™ System is connected and operated as a standard API/ ISO pressure balanced Hot Stab system. The stab is simply pushed into the receptacle to connect and pulled out to disconnect. The main difference between the Valve Stab™ and the standard Hot Stab wrt to operation is that the Valve Stab™ must be inserted into receptacle with correct alignment. After insertion, the valve function is easily operated by use of the manipulator.

All operation is performed directly by use of a Standard ROV manipulator.

### REVISION CHANGE/RECORD

REV	REASON FOR REVISION/ DESCRIPTION OF CHANGES
01	Issued for Use

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## TECHNICAL DOCUMENT

### 1. INTRODUCTION

The Blue Logic Valve Stab™ is a patented hydraulic connector system combining technology from standard Hot Stab connectors and Ball Valves into a very compact and lightweight subsea connector system. The unique features obtained allows for 100% leakage free subsea connection with full system pressure. Since the system includes built-in valve functionality both in the stab and receptacle side, subsea valve and connector panels can be designed extremely compact compared to alternative solutions.

The Valve Stab™ technology is relevant for use in almost all subsea connector applications and can be easily operated by use of either Diver or ROV. The System is fully pressure balanced and does not introduce any axial forces into the connector or panel system. When the system is connected and the ports are opened, the Stab Connector is locked into the receptacle system automatically.

Despite all included functions, the Valve Stab™ System is a very simple and robust construction with very few moving parts. All seals can easily be replaced offshore. Receptacle seals can even be replaced subsea by use of dedicated seal replacement tool.

This document includes a technical description, sequences and recommendations for safe operations and relevant aspects for maintenance and storage.

#### 1.1. DOCUMENT USE

This document shall be used as general information for all aspects related to safe use, installation, removal, maintenance and storage of the Valve Stab™ System. Included in this Operation and Maintenance Manual are sequential step-by-step procedures for typical offshore operations which can be used for establishing detailed specialized offshore/subsea procedures. These lists can also be used for documentation of performed work and sequences if required.

The Valve Stab™ System includes different sizes, variants and configurations. For updated full program overview, please contact Blue Logic AS. This document covers Operation and Maintenance of the Ø60mm Blue Logic Valve Stab™ program. Additional manuals are however also available for special variants or client/ project specific designs.

#### 1.2. ABBREVIATIONS

ROV:	Remotely Operated Vehicle
HPU:	Hydraulic Power Unit
FAT:	Factory Acceptance Test
MOB:	Mobilisation
DEMOB:	Demobilisation

## TECHNICAL DOCUMENT

### 2. TECHNICAL DESCRIPTION

#### 2.1. GENERAL

The Ø100 Valve Stab™ program includes versions with alternative number of hydraulic ports and configurations. In addition, the complete programs also includes systems with different number of ports and internal bore. Dedicated technical description and further documentation is available for different sizes although all Valve Stab™ Systems are based on the same core technology and will be operated using the same principles.

#### 2.2. STAB

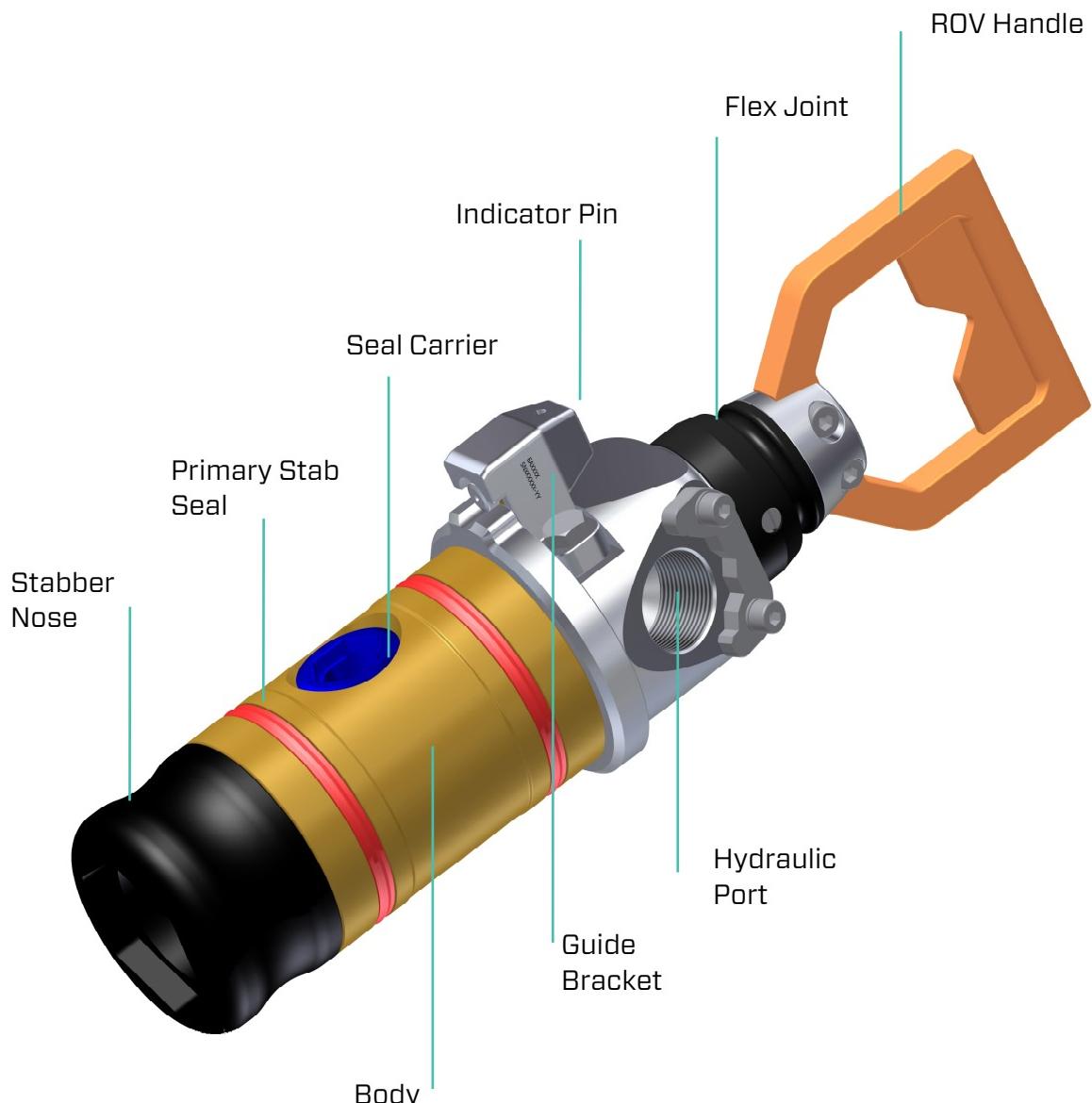


Figure 1 Ø100 Single Port Valve Stab

## TECHNICAL DOCUMENT

**2.2.1. Indicator Pin**

The purpose of the Valve Stab™ Indicator pin is to visually confirm correct mating of the Valve Stab™ into the Receptacle prior to flushing of cavities or operation of the Valve Stab™ Valve function. The Indicator pin is black and will pop out approx 4mm when the Stab is correctly mated as illustrated on below figures.

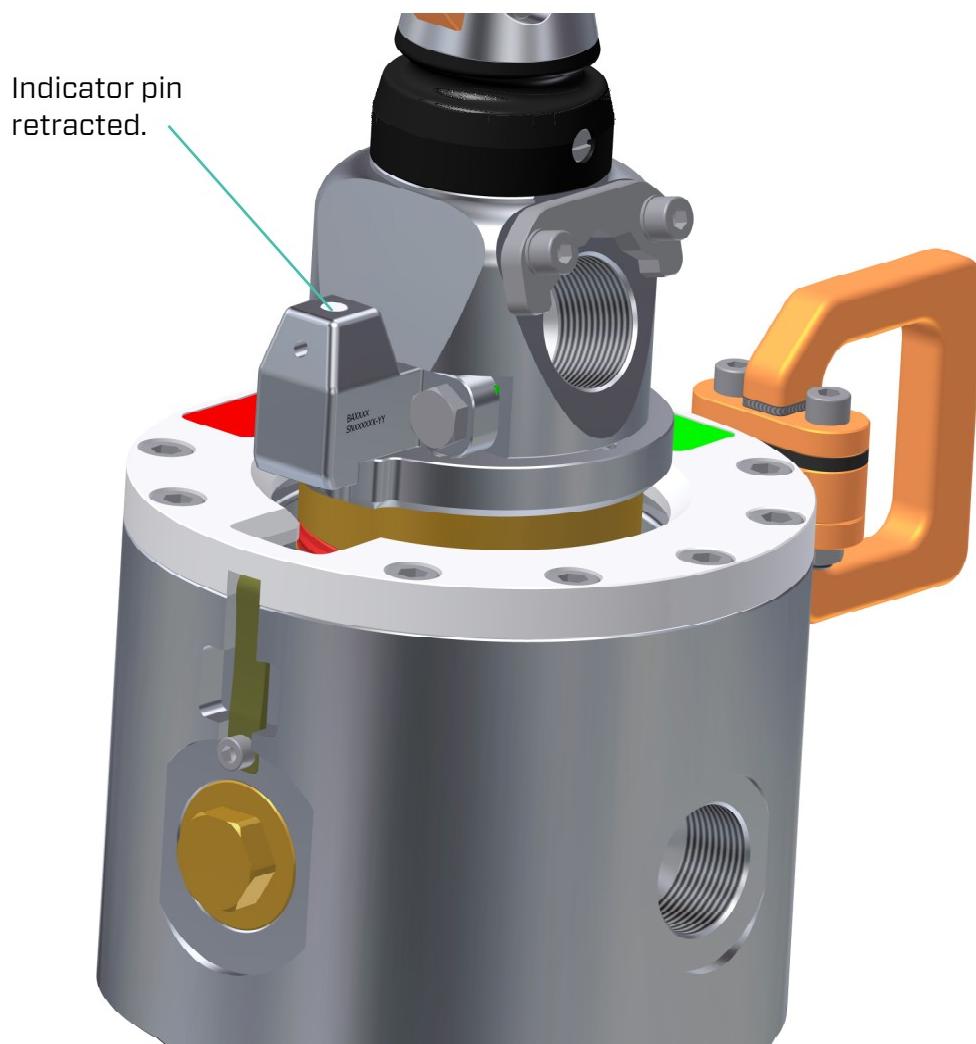


Figure 2 Prior to mating of Stab into Receptacle

## TECHNICAL DOCUMENT

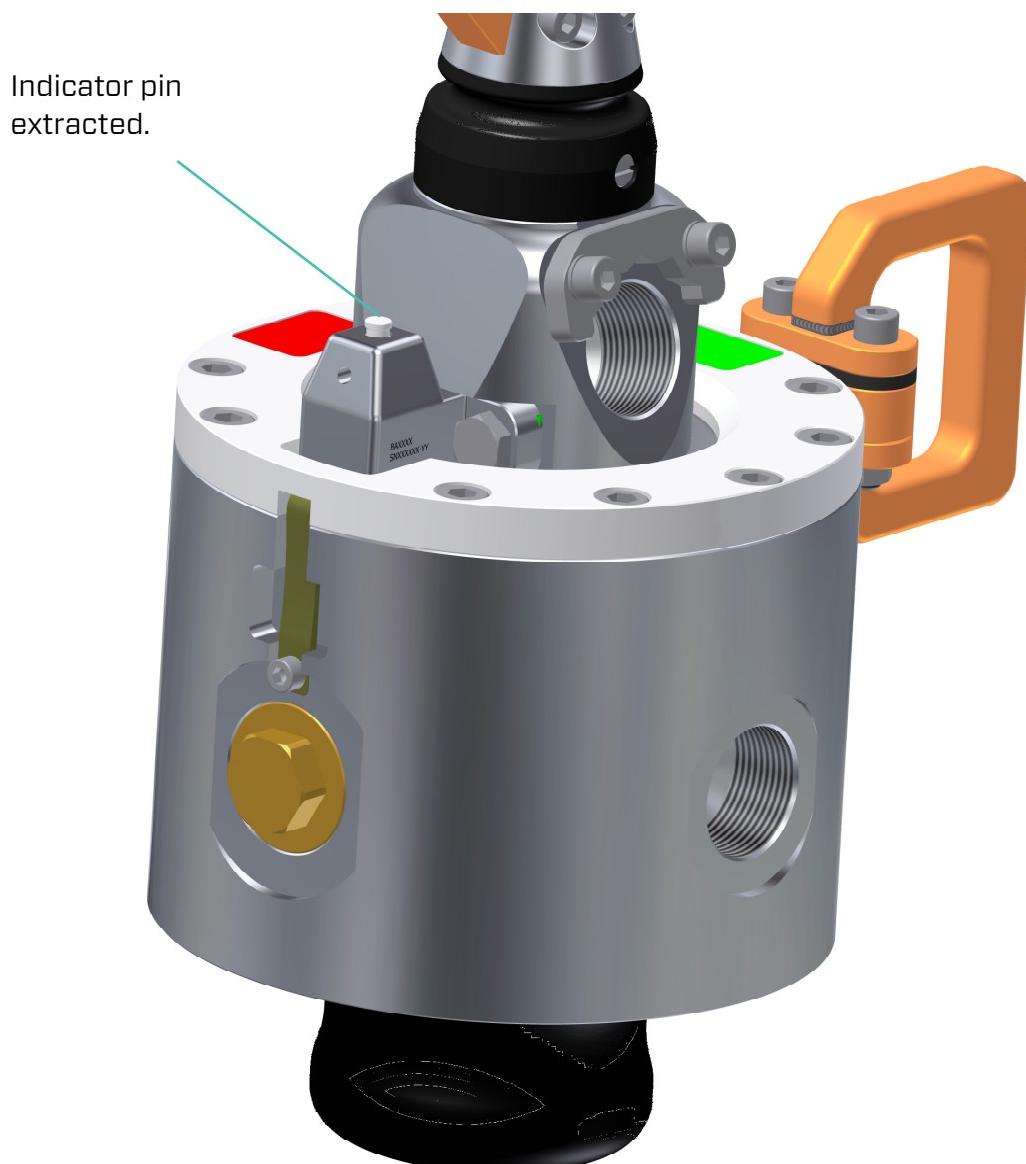


Figure 3 Stab correct mated into Receptacle

## TECHNICAL DOCUMENT

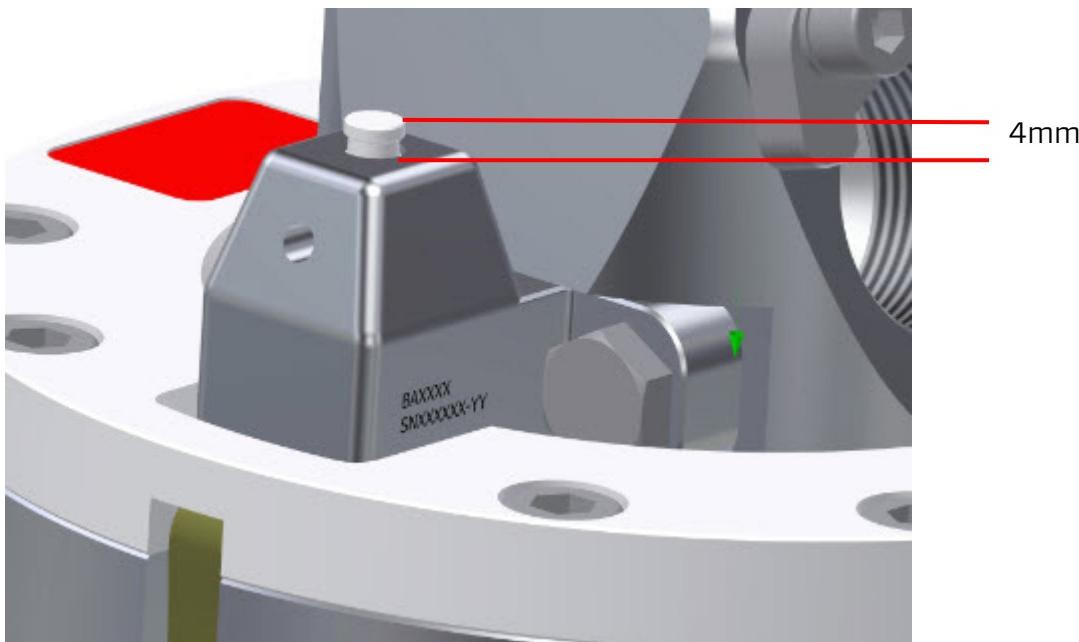


Figure 4 Indicator Pin movement

### 2.2.2. Stabber Nose

The Stabber Nose ensures correct and gentle guiding of the Stab into the Receptacle. Stab noses are normally constructed by use of an Aluminum Bronze alloy or PEHD1000 to protect the receptacle internals. The Stabber nose is connected to the Stabber by use of threads and can be unscrewed by use of a Hex umbraco tool. For the Ø100 Valve Stab system, the Hex key size is 34mm.

The Stabber Nose also secures and locks the Seal Carrier onto the Stab. Therefore correct installation and tightening of the stabber nose is important and should be verified prior to operation.

### 2.2.3. Primary Stab Seal

The Primary Stab Seals separates the different hydraulic ports and seals toward the receptacle. Different alternative seal profiles and materials are available depending on application and fluid. Standard Blue Logic seal material is HPUR, which is compatible with most relevant fluids and have a mechanical properties thus securing for long service life without need for replacement. The Primary Stab Seals can however easily be replaced offshore without need for any disassembly of the stab. Please see following sections for details with regards to seal replacement.

### 2.2.4. Seal Carrier

All stabber seals are placed in the Valve Stab™ seal carrier, both the internal Core Seals and the outer Primary Seals. The Seal Carrier is replaced by unscrewing the stabber nose and seal cartridges. Note: Seal cartridge are secured with Loctite 577 and needs to be heated to approx. 80-100 deg before unscrewing. Use hot water or air gun to heat. (If air gun is used, never heat directly on seals)

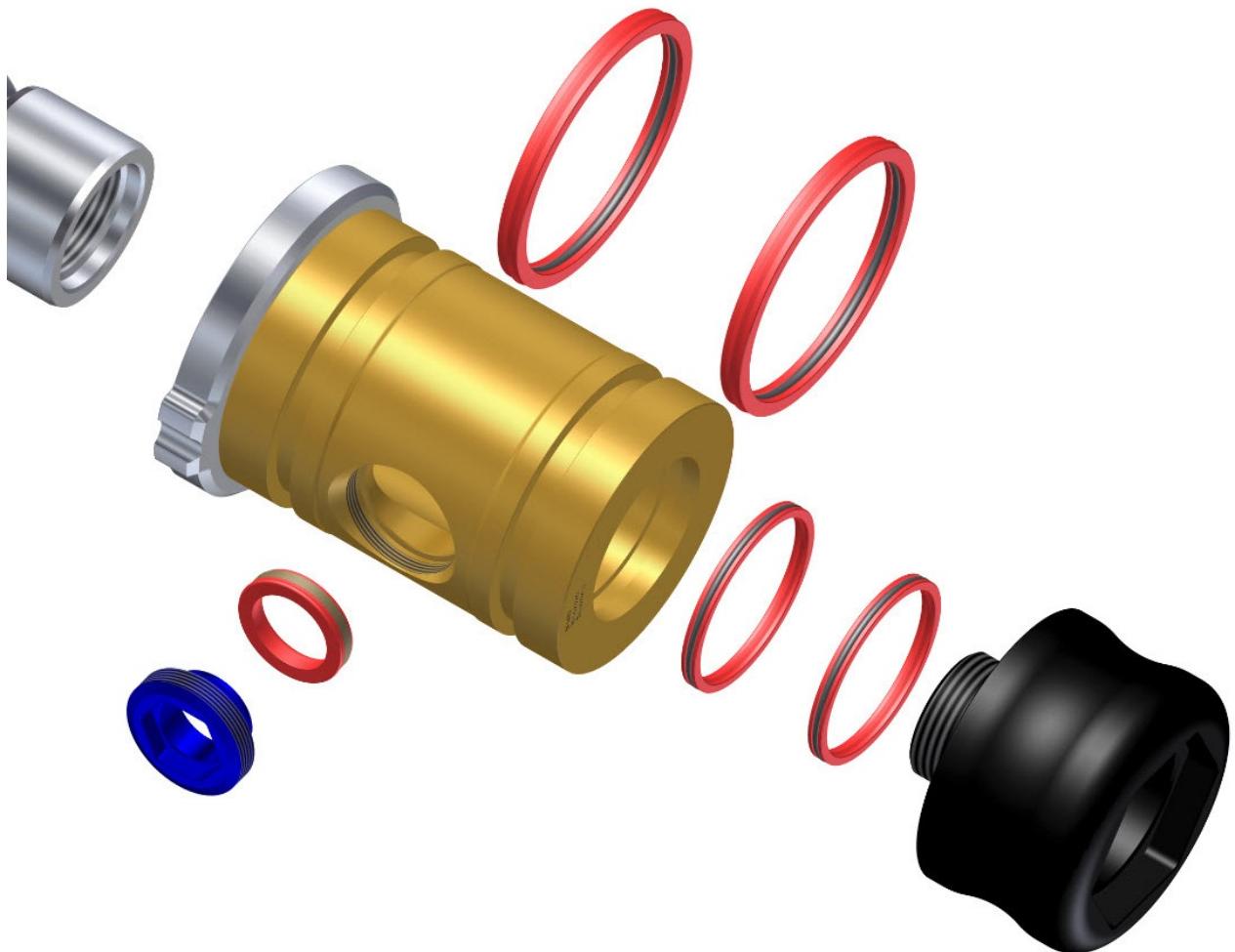


Figure 5 Valve Stab™ Seal Carrier with internal and external seals

### 2.2.5. Seal Cartridges

The Seal Cartridges includes the Spherical Core Seal which seals toward the Valve Stab™ Core placed inside the Seal Carrier. The Seal Cartridges can be unscrewed by use of a 26mm Hex Unbraco key for replacement or inspection. Please see section for maintenance with regards to replacement of seal or seal systems.

Note: Seal cartridge are secured with Loctite 577 and needs to be heated to approx. 80-100 deg before unscrewing. Use hot water or air gun to heat. (if air gun is used, never heat directly on seals)

## TECHNICAL DOCUMENT

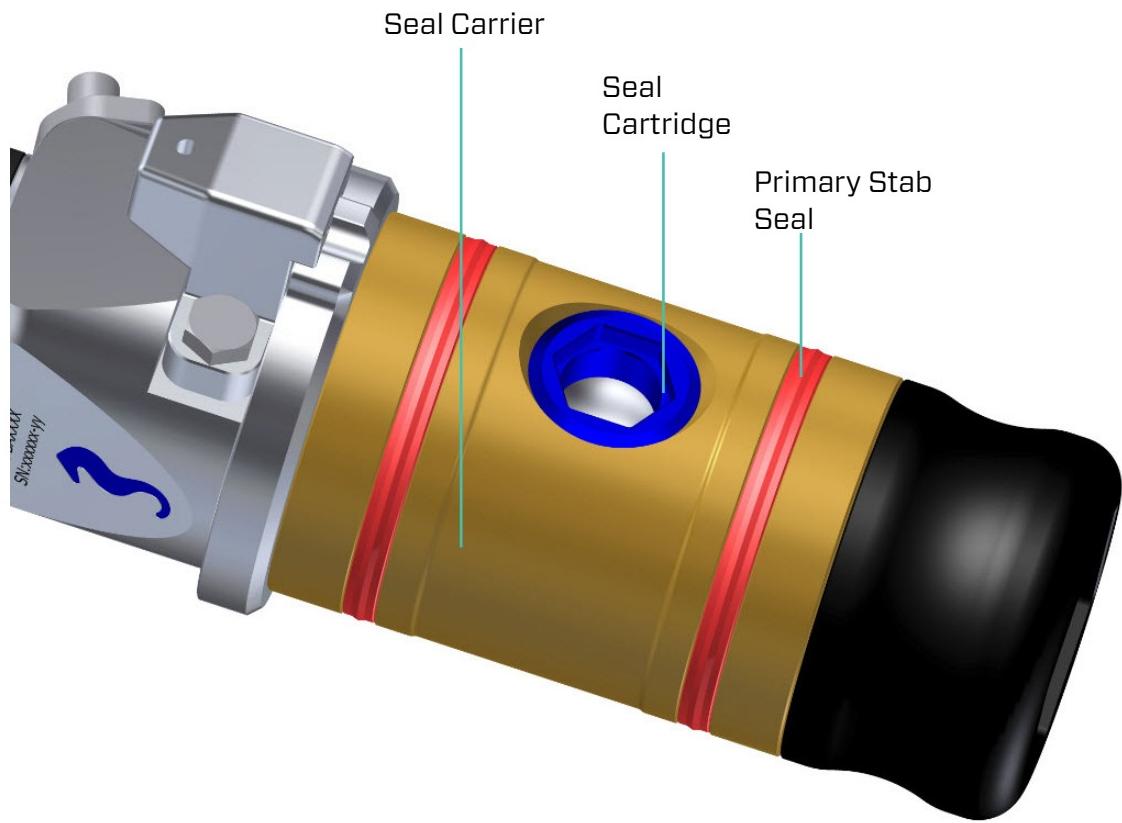


Figure 6 Stab Seal Carrier and Seal Cartridge

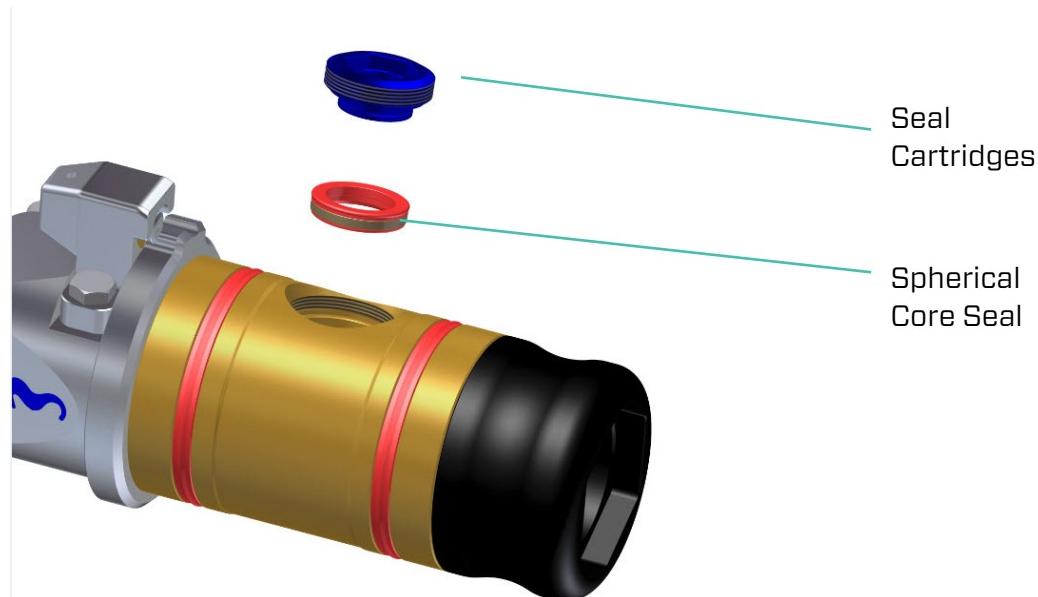


Figure 7 Seal Cartridges removed

## 2.2.6. Hydraulic Ports

The Ø100 Valve Stab™ system is delivered with 1 1/4" BSP female hydraulic port.

A mechanical lock for the BSP port effectively secures the BSP connector.

## 2.2.7. Flex Joint

The Flex Joint connects the Valve Stab™ body to the ROV Handle. It consists of an outer flexible element and an inner mechanical connection. The Flex Joint allows for a smooth angle deviation of approx 20 degrees in all directions between the ROV handle and Valve Stab™. The flex element can easily be replaced, see maintenance section for details wrt to replacement of flex element.

## 2.2.8. ROV Handle

The Valve Stab™ can be delivered with different alternative ROV Handles. Most common is the ROV "D-Handle". ROV Handles can easily be replaced by unscrewing the ROV Handle bolts.

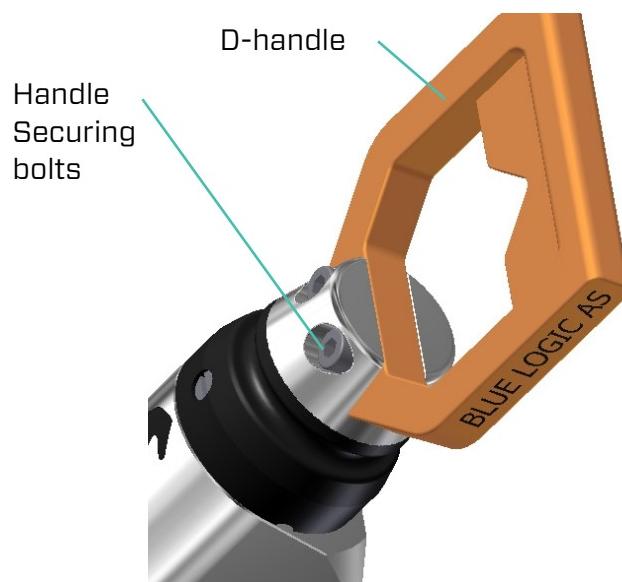


Figure 8 ROV Handle

## 2.2.9. Guide Bracket

The Guide Bracket ensures that the Valve Stab™ is aligned correctly prior to connection into the Receptacle. The Guide Bracket fit's into the machined Orientation Groove in the receptacle and once correct inserted triggers the receptacle position lock system.

## TECHNICAL DOCUMENT

### 2.3. RECEPTACLE

The Valve Stab™ receptacle consists of the following main parts;

1. Outer Housing
2. Inner Centre Core
3. ROV/Diver Handle
4. Seal Cartridges
5. Internal seals
6. Bracket/ securing interface
7. Orientation Groove
8. Hydraulic Ports
9. Receptacle Top Plate

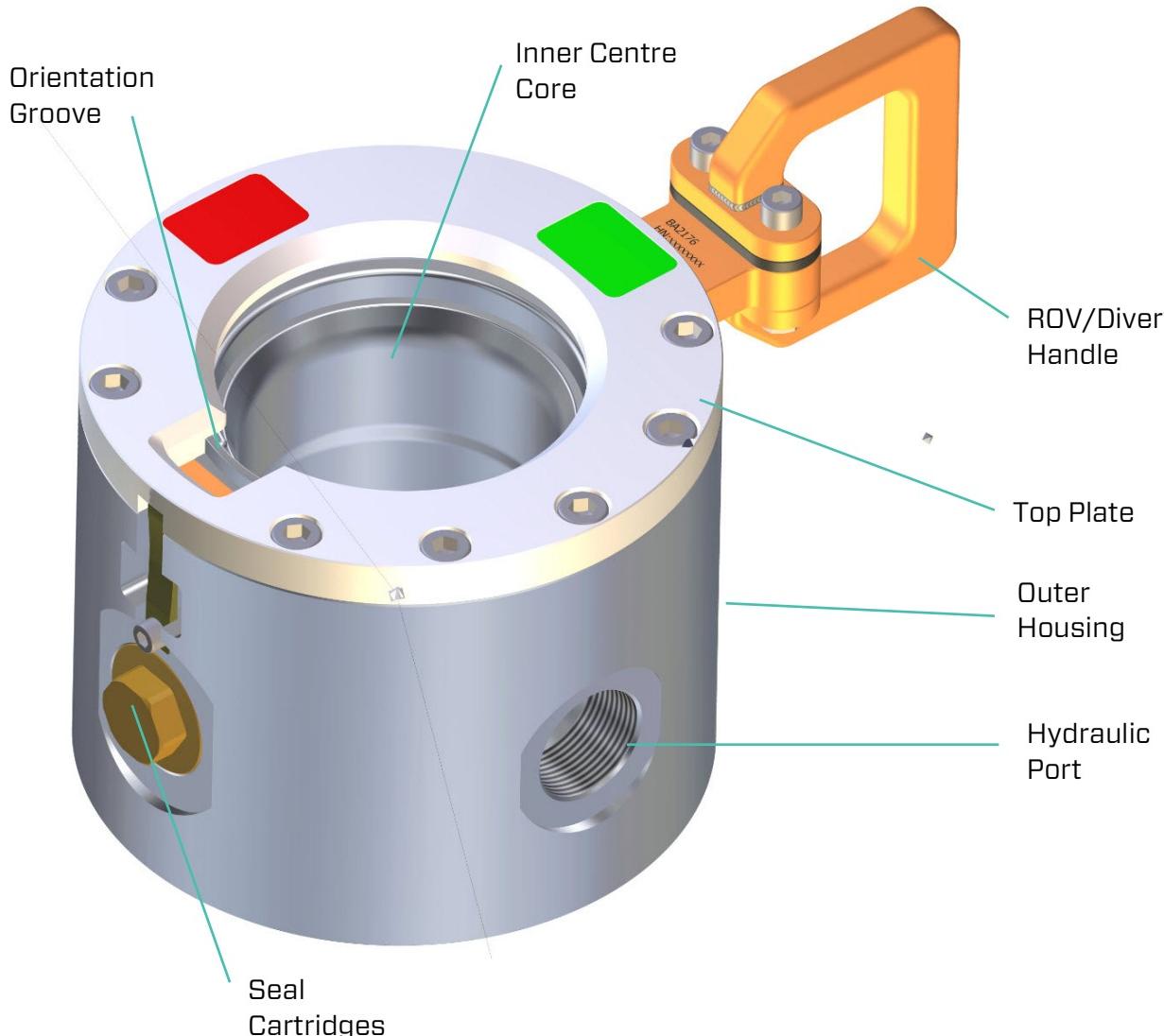


Figure 9 Receptacle

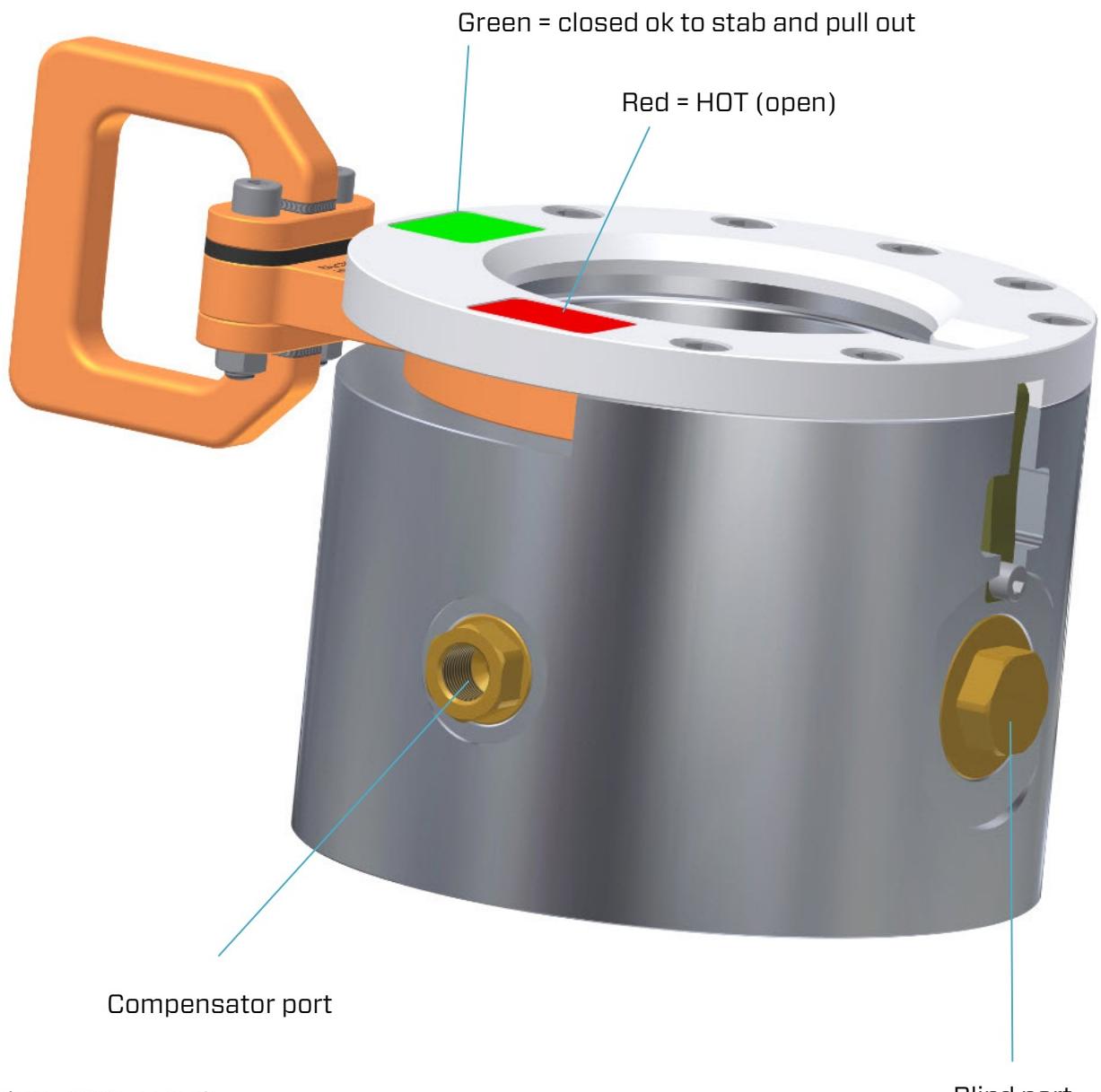


Figure 10 Receptacle

## TECHNICAL DOCUMENT

### 2.3.1. Outer Housing

The Outer Housing is constructed by use of hard anodized aluminium. The Outer Housing includes the hydraulic ports, interface for installation (securing interface) and interface for seal cartridges as further described in following sections. All Valve Stab™ receptacle seals are placed inside the Outer Housing.

### 2.3.2. Center Core

The Inner Center Core rotates inside the Outer Housing thus opening and closing the hydraulic ports. It is constructed by corrosion resistant high strength alloy to reduce wear and improve lifetime.

#### 2.3.2.1. Seal Cartridges

Similar as for the male Valve Stab™, the Seal Cartridges contains the Spherical Cores Seals which seals towards the Inner Centre Core. The Seal Cartridges is secured by use of Loctite 577 and can be unscrewed by use of a 28mm hex key.

### 2.4. "COMPENSATOR" PORT

The compensator port is connected to the Receptacle Output port when the Valve Stab receptacle is closed. When a Stab is inserted into the receptacle and the Valve Stab ports are opened (by operating the receptacle ROV handle), this compensator port closes simultaneously.

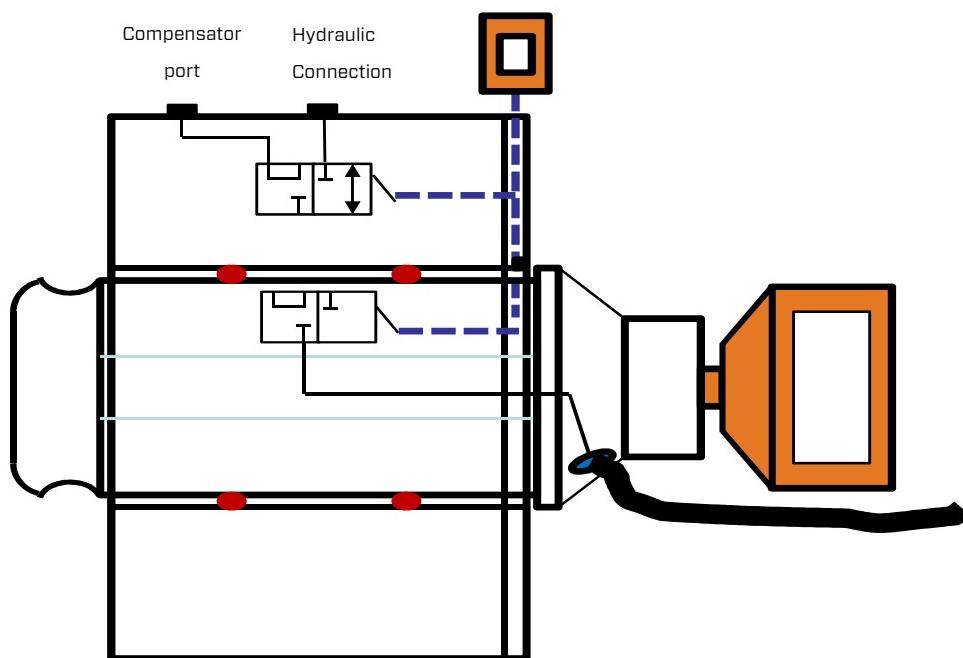


Figure 11 Hydraulic schematic Valve Stab w/ compensator port

## TECHNICAL DOCUMENT

### 2.4.1.1. ROV/Diver Handle

The ROV handle operates the Valve Stab™ Open/Close function. It is to be rotated in order to operate the Valve Stab™.

#### Operate ROV Handle Clockwise (green area)

- The Valve Stab™ valve functions are CLOSED and the stab can be inserted or retracted from the receptacle

#### Operate ROV Handle Counter Clockwise (red area, "Hot")

- The Valve Stab™ valve functions are OPEN and the stab is LOCKED in position into the receptacle.

**NOTE: The Valve Stab™ must be correct and fully inserted into the Valve Stab™ Receptacle in order to OPEN the Valve Stab™ valve functions.**

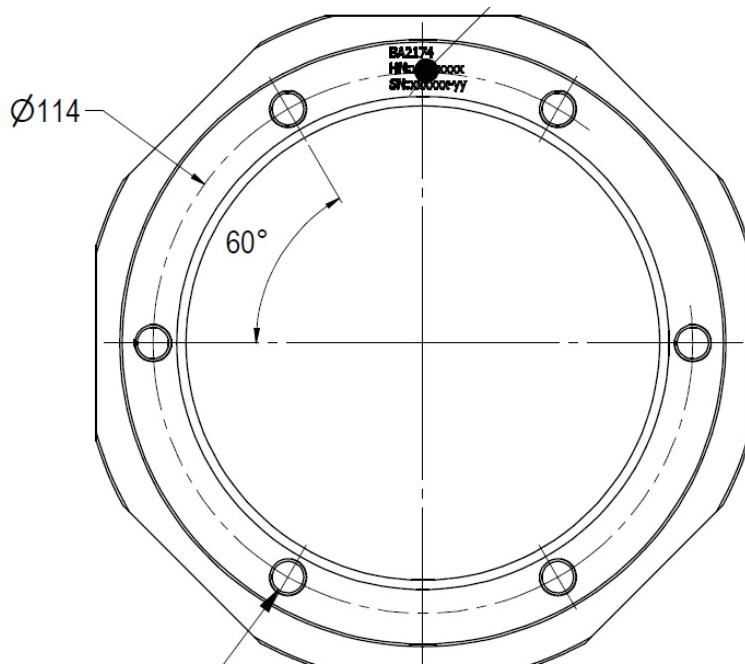
### 2.4.2. Internal seals

Valve Stab™ receptacle internal seals are not shown on above figure. The seals are placed on the inner side of the outer housing. The Center Core will need to be removed from the outer housing in order to replace the internal seals.

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**2.4.3. Receptacle Operation Interface**

The Receptacle Operation Interface can thus be used for remote operation of the Valve Stab™ function. Typically this can be achieved by installing a hydraulic, mechanical or electrical actuator.



M8x1.25 - 6H 16mm DEEP

*Figure 12 Receptacle operation interface*

## TECHNICAL DOCUMENT

### 2.4.4. Bracket/ securing interface

The Bracket Securing interface is used to securing the Receptacle onto the ROV or subsea equipment.

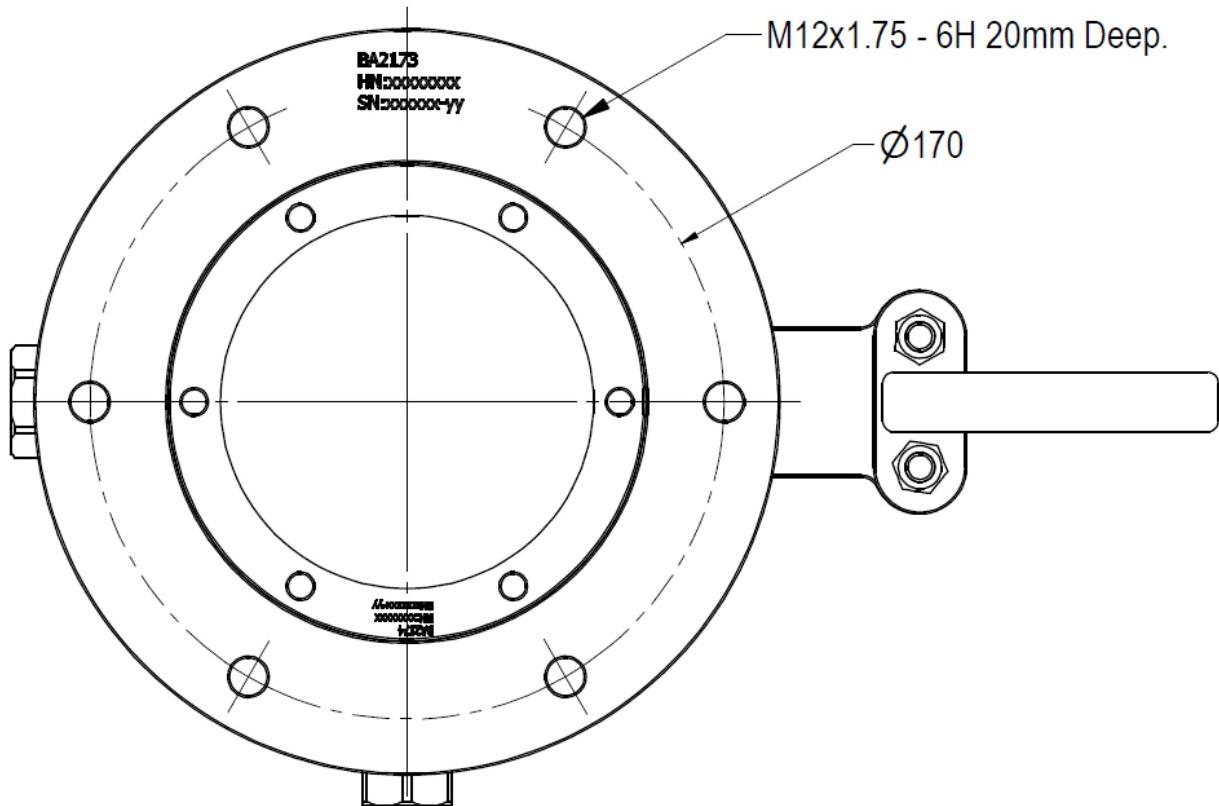


Figure 13 Receptacle securing interface

### 2.4.5. Hydraulic Ports Receptacle

The hydraulic ports in the receptacle have the same port size and marking as the Valve Stab™:

Output Ports:	1-1/4" BSP female
Compensator port	1/2" BSP female

### 2.4.6. Receptacle Top Plate

The Receptacle Top Plate is bolted onto the Receptacle outer housing. It includes the Orientation Groove and color marking for Valve Stab™ Valve position.

There are three equal interfaces placed in different orientations on the receptacle for optimal placement of the receptacle on the equipment.

## TECHNICAL DOCUMENT

**2.4.7. Orientation Groove**

The Orientation Groove in the Receptacle ensures correct orientation of the Valve Stab™ when inserting into the receptacle. When the Valve Stab™ is fully inserted into the Receptacle, the Valve Stab™ Guide Bracket activates a Lock Spring in the Orientation Groove thus allowing for operation of the Valve Stab™ and Receptacle Valve Mechanism.

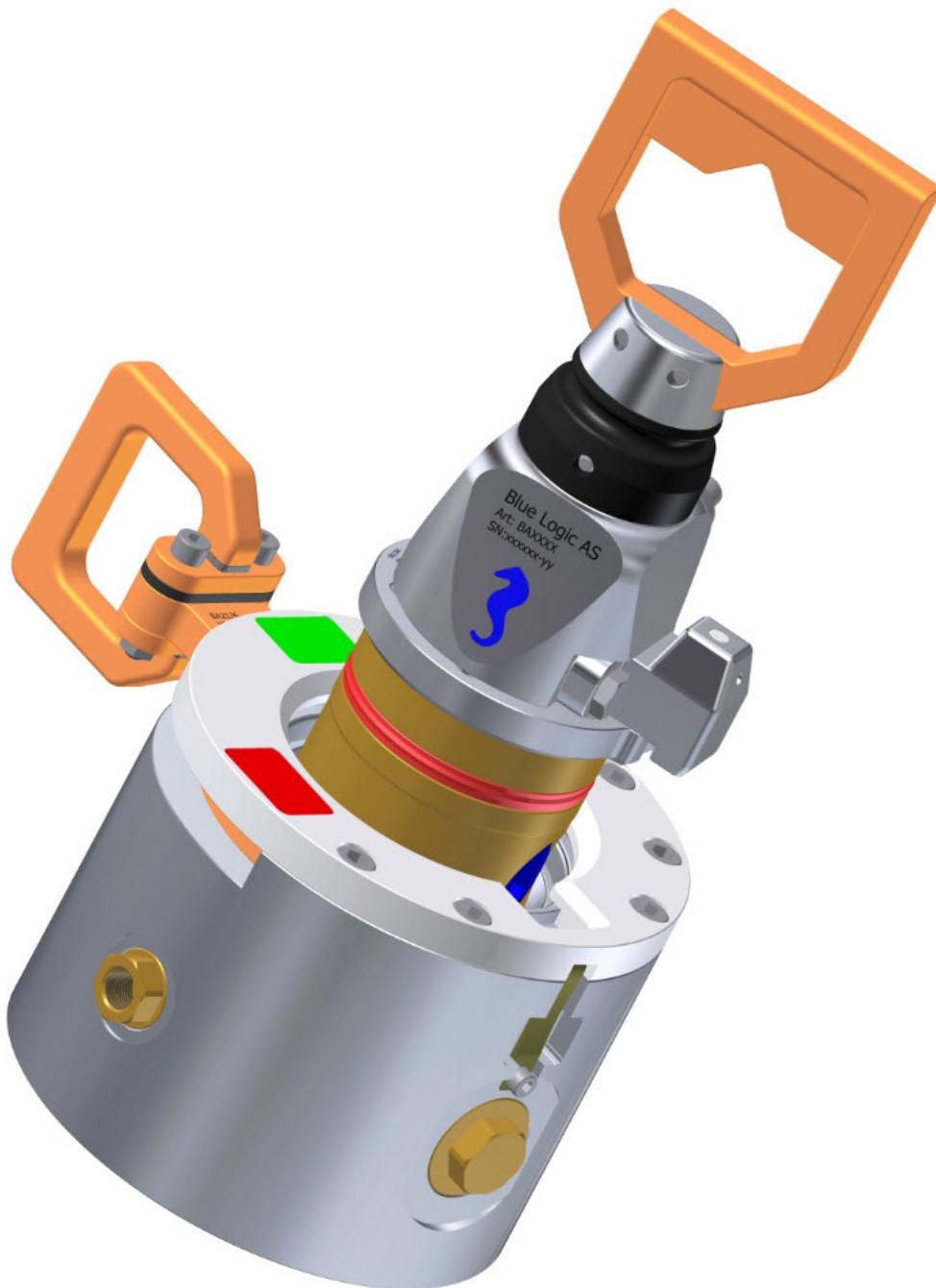


Figure 14 Valve Stab™ and receptacle mating

## TECHNICAL DOCUMENT

**2.4.8. Optional 'Fail Safe Close Actuator**

NA

**2.4.9. Optional Connection Flushing System**

One of the unique features with the Valve Stab™ System is the ability to perform a 100% clean subsea multiport connection. The cavity volume trapped between the stab and receptacle is very small compared with traditional connector systems. In addition, this cavity volume can be flushed prior to opening the Valve Stab™ ports. There are different ways of performing this flushing process depending on the Stab/ Receptacle configuration and number of hydraulic ports. Blue Logic has developed optional special equipment to effectively perform this flushing process.

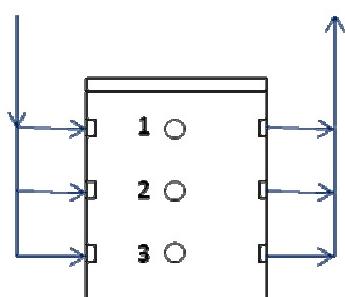


Figure 15 Alternative 1 Flushing principle

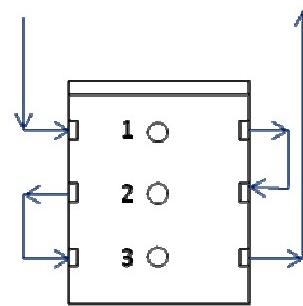


Figure 16 Alternative 2 Flushing principle

In general, the flushing shall be performed by flushing through the receptacle flushing ports prior to operation of the Valve Stab™ function.

Contact Blue Logic for further information wrt flushing of Valve Stab Cavities

**2.4.10. Flushing using Hydraulic Supply Directly from ROV**

NA

**2.4.11. Flushing using Blue Logic Valve Stab™ Flushing Unit**

NA

## TECHNICAL DOCUMENT

### 3. INSTALLATION

#### 3.1. RECEPTACLE

The Receptacle will normally be installed into a ROV Panel by use of a bracket or by use of bolts directly.

Receptacle installation interface is as shown on below figure:

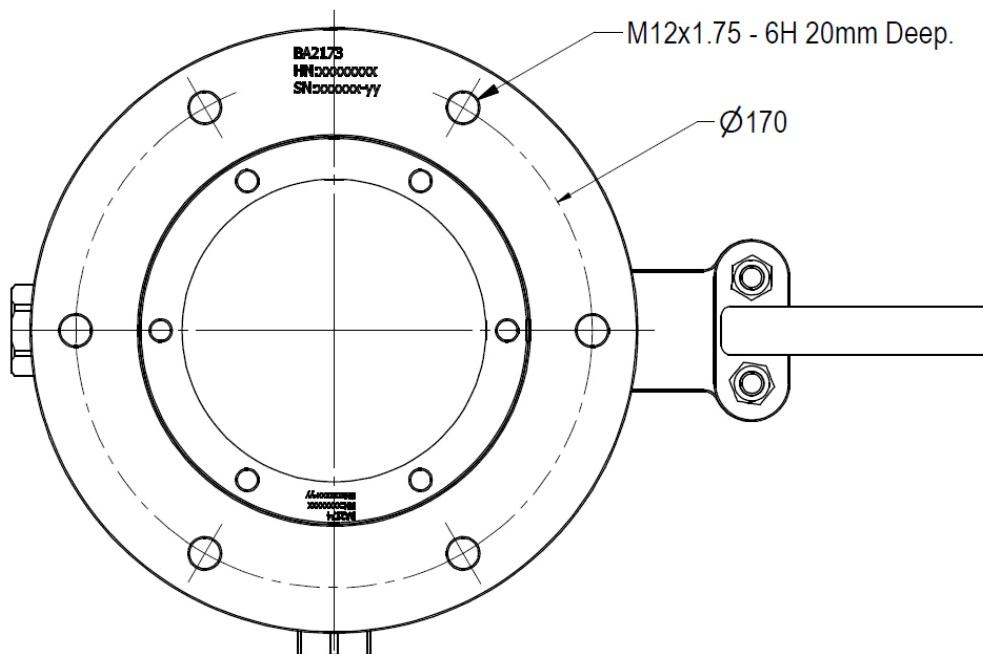


Figure 17 Rear End of Valve Stab Receptacle

**Note 1:** If dedicated CP system is present, ensure that the receptacle is correctly earthed and connected to this. Use separate cable if required.

**Note 2:** The receptacle outer part is made of hard anodized aluminium.

##### 3.1.1. Hydraulic installation

The hydraulic functions shall be connected to the Receptacle hydraulic ports by use of hoses or piping. Hydraulic ports on the receptacle are described in above Section 2.4.5

### 3.2. STAB

#### 3.2.1. Hydraulic connection

Hydraulic connection to the receptacle is performed by use of standard hydraulic BSP fittings.

## TECHNICAL DOCUMENT

### 4. PREPARATION FOR USE

#### 4.1. ONSHORE PREPARATIONS

Prior to shipping offshore a mobilisation/ verification should be performed. All functions should be tested and verified. The following check list should be used as a guideline for activities to be performed prior to offshore mobilisation:

##### 4.1.1. Mobilisation check list

No.	Description	Chk/Verified
01	Inspect Stab and receptacle visual	
02	Inspect surface treatment undamaged	
03	Inspect Stab Hydraulic Port Seal areas for damage	
04	Inspect Receptacle Hydraulic port seal areas for damage	
05	Inspect Receptacle seal areas undamaged without scratches	
06	Inspect Stab Guide Bracket undamaged	
07	Inspect Receptacle Orientation groove and verify functionality of the guide/orientation system.	
08	Verify that the stab and receptacle Valve function can not be operated prior to mating. Mate Stab and receptacle.	
09	Verify activated indicator pin on stab (approx 4mm extracted)	
10	Verify that the Valve Stab™ valve function can be operated when connected.	
11	Insert and operated both Stab and receptacle system. Verify smooth and correct movement of Valve function.	
12	Verify Correct packing and documentation in the transport box. The transport box should include as a minimum Valve Stab™ system Operation and Maintenance Manual	

## TECHNICAL DOCUMENT

**5. OPERATION****5.1. OFFSHORE PREPARATIONS****5.2. PRE DIVE CHECK**

Prior to dive, the Valve Stab™ System should be inspected and function tested.

**5.2.1. Stab Pre Dive Chk List**

No.	Description	Chk/Verified
01	Perform a visual inspection - Seals - Seal Areas - Fittings - Hoses - ROV Handle - Flex Joint - Guide Bracket - Hose Tension Relief - Hose conditions, pressure rating, lengths and hose protection	
02	Verify that the Valve Stab™ is closed and cannot be opened prior to insertion into receptacle	
03	Insert the Valve Stab™ into a Valve Stab™ receptacle, ensure smooth movement and observe friction force.	
04	Open the Valve Stab™ System through the ROV/Diver handle. If a fail safe actuator or similar remote operation mechanism is installed, verify functionality of this.	
05	Close Valve Stab™ and disconnect from receptacle.	
06	Inspect Seals and seal areas.	

**5.2.2. Receptacle Pre Dive Chk List**

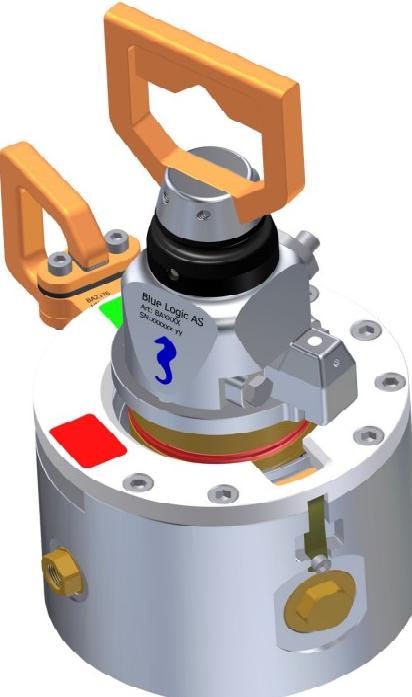
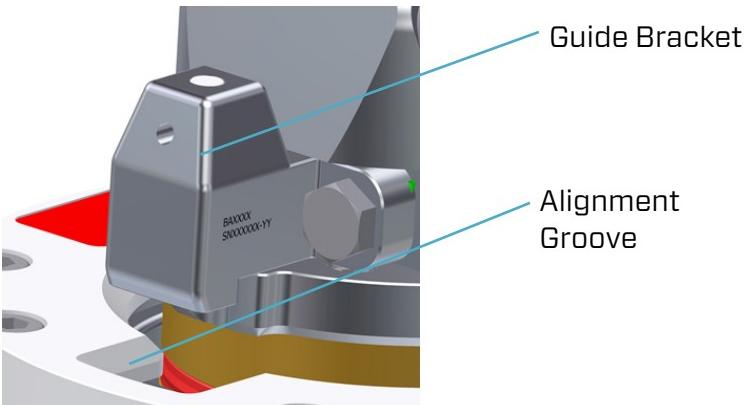
No.	Description	Chk/Verified
01	Visual inspect receptacle internal surface finish and entrance area.	
02	Verify access for ROV and stab into receptacle	
03	Inspect all hoses, piping and fittings for leakage. Pay special attention to seal system.	
04	Verify that the Receptacle valve function can not be operated when the Male stab is not inserted into the receptacle.	

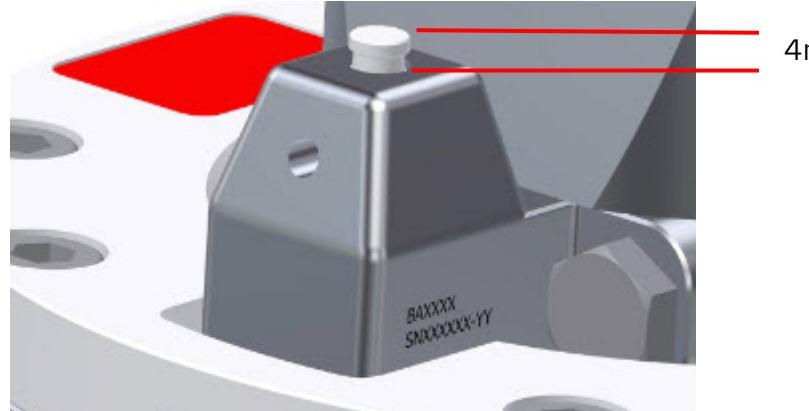
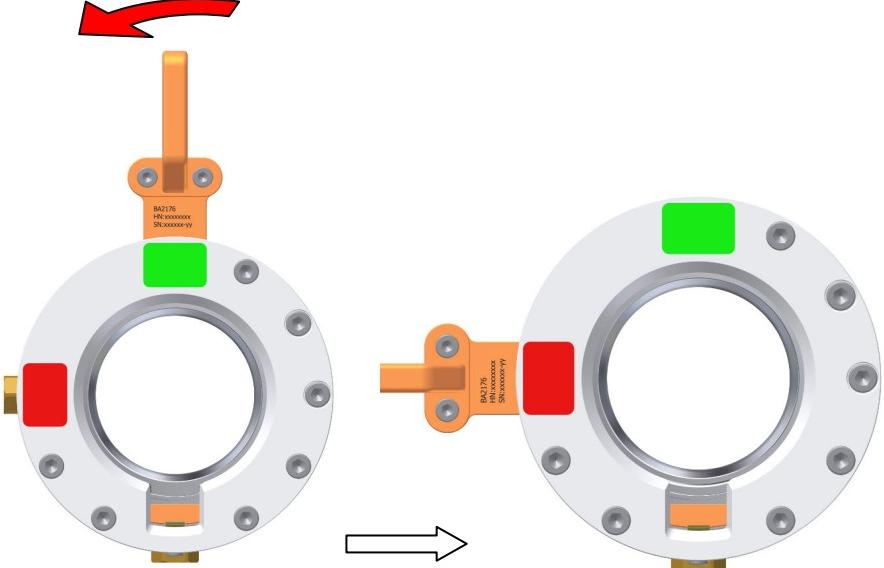
05	Insert a Valve Stab™ into the receptacle. Verify correct installation and access.	
06	Open the Valve Stab™ and receptacle valve function by use of the ROV/Diver Handle.	
07	If a fail safe close system or a remote operation actuator is installed; inspect and verify all functions.	
08	Close Valve function and disconnect Valve Stab™ from receptacle	
09	Perform a visual inspection of the receptacle.	

### 5.3. SUBSEA CONNECTION

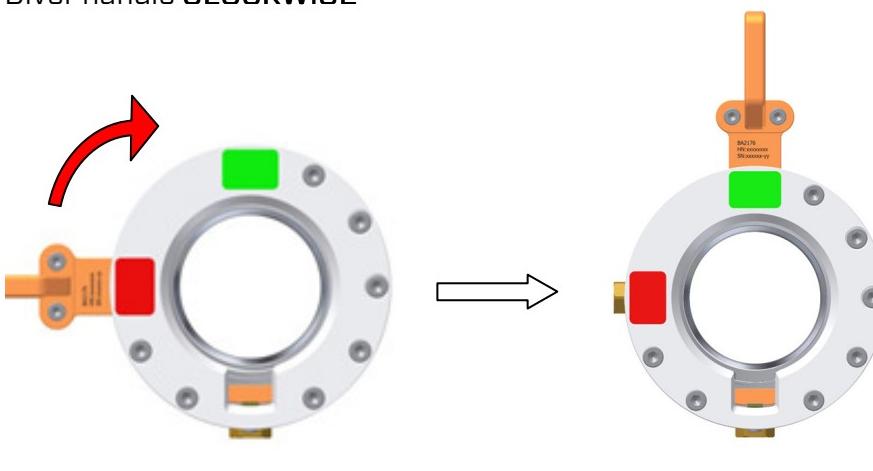
No.	Description	Chk/Verified
01	Visually inspect Valve Stab™ Receptacle prior to subsea connection. Verify ROV/ Diver access and general condition of the Valve Stab™ Receptacle in front of, and behind the panel.	
02	Inspect Valve Stab™ ROV/ Diver handle. Verify that the Valve Stab™ position is Closed (Green Area) as indicated on figure below.	



03	<p>Start Insertion into receptacle. Use a loose manipulator grip if possible.</p> 	
04	<p>Align stab into receptacle and gentle slide/push stab down. Rotate Valve Stab™ in order to align Stab Guide Bracket and Receptacle orientation groove. When correct aligned, push the stab down and fully into the Receptacle. The indicator pin will extract approx 4mm</p> 	

05	<p>Fully insert the Valve Stab™ into the Receptacle. Ensure correct engagement of Guide Bracket/Orientation.</p> <p>Verify indicator pin movement:</p>  <p>4mm</p>	
06	<p>Operate Receptacle ROV/Diver handle from CLOSED (Green Position) COUNTER CLOCKWISE to OPEN position stab system.</p>  <p>Closed Position (Stab free for insertion)</p> <p>Open Position (Stab locked into receptacle)</p> <p>Note: It is always recommended to open or close without pressure and flow over the Valve Stab™ system</p>	
07	<p>Verify hydraulic ports open and inspect Receptacle/ Stab for leakages. Operate desired hydraulic functions.</p>	

#### 5.4. SUBSEA DISCONNECTION

No.	Description	Chk/Verified
01	Visually inspect Valve Stab™ Receptacle prior to subsea disconnection. Verify ROV/ Diver access and general condition of the Valve Stab™ Receptacle in front of, and behind the panel.	
02	<p>Close the Valve Stab™ System Valve function by operating the ROV/ Diver handle <b>CLOCKWISE</b></p>  <p>Note: It is always recommended to open or close without pressure and flow over the Valve Stab™ system</p>	
03	Pull the Valve Stab™ out from the receptacle. Verify no leakages and perform a visual inspection.	
04	Continue with operation	

#### 5.5. POST DIVE CHECK

No.	Description	Chk/Verified
01	Recover Valve Stab™ equipment to deck.	

02	Perform a visual inspection <ul style="list-style-type: none"> <li>- Seals</li> <li>- Seal areas</li> <li>- ROV Handle</li> <li>- Flex Joint</li> <li>- Hoses and piping</li> <li>- Fittings</li> <li>- Surface treatment</li> </ul>	
03	Flush all equipment with fresh water	
04	Dry off equipment and apply protective oil prior to storage	

## 6. MAINTENANCE

### 6.1. GENERAL

The Valve Stab™ system is a simple and robust Subsea connection system with few critical moving parts. If moving parts is not filled with salt and sand/ dirt particles, but cleaned and lubricated, the only parts which will need to be routinely replaced is the seal system.

There are however a few important inspections points which shall be performed routinely in order to guarantee problem free use and operation of the Valve Stab™ System.

- MOB/Demob inspection and control
- Daily inspection during offshore operations
- Weekly routinely inspection during offshore operations
- Yearly inspection and Maintenance

All above recommended inspection and maintenance can be performed by operator, it is however recommended to return the Valve Stab™ System to Blue Logic for a yearly inspection and maintenance to ensure minimum 20years of problem free use.

For MOB/demob, please see above Section 4.1.1

For Daily inspection during offshore operations; please see above Section 5.2 for pre-dive activities and Section 5.5 for post dive.

## 6.2. WEEKLY MAINTENANCE

No.	Description	Chk/Verified
01	Perform a visual inspection of Stab and receptacle. Inspect Surface treatment and verify no corrosion issues. Special attention should be to the following: <ul style="list-style-type: none"><li>- Seals</li><li>- Seal areas</li><li>- ROV Handle</li><li>- Flex Joint</li><li>- Hoses and piping</li><li>- Fittings</li><li>- Surface treatment</li><li>- Stab Guide Bracket</li><li>- Receptacle Orientation Groove</li></ul>	
02	Insert the Valve Stab™ into receptacle. Verify correct engagement of orientation groove, guide bracket and Indicator Pin	
03	Operate the Valve Stab™ valve function by use of the ROV/Diver handle. Verify smooth movement	
04	Close the Valve Stab™ valve function, verify smooth movement	
05	Pull the Valve Stab™ out of the receptacle and verify that the valve function can not be operated on either the Receptacle or Stab	
06	Ensure protective oil applied and no water/moisture entrapped on critical parts.	
07	Operate in dedicated aluminium transport box.	

## 6.3. MONTHLY MAINTENANCE

No special activities are required on a monthly basis. If the Valve Stab™ system has been extensively used and repeatedly exposed to dirt and aggressive fluids, all Stabber and receptacle seals should be inspected and replaced if required.

## 6.4. YEARLY MAINTENANCE

No.	Description	Chk/Verified
01	Inspect all external and internal Valve Stab™ Seals. Replace if required.	
02	Inspect all external and internal Receptacle Seals. Replace if required.	
03	Check all mechanical functions, verify smooth operations. Inspect for scratches and general wear, lubricate all moving parts.	
04	Function test Stab and Receptacle and perform a full leakage test.	

## TECHNICAL DOCUMENT

**6.5. SEAL REPLACEMENT****6.5.1. Main Outer Seal (Stab)**

Sequence for replacement of the Main Outer Stab Seals:

No.	Description	Chk/Verified
01	Remove old seals by use of a sharp knife. Cut the seals, but be very carefully not to damage seal surfaces.	
02	Heat the new seals to 80-100 degrees using hot water.	
03	Stretch the new seals gently by hand. Slide the seals over the outer stab body. Use water or oil to lubricate.	

As an option; a dedicated Seal Replacement Tool is available. Please contact Blue Logic for further details.

**6.5.2. Seal Cartridges and spherical core seals (Stab)**

During normal use, the seal spherical core seals does not need to be replaced. They will be inspected and replaced if required during the recommended yearly service. If however the seals are to be replaced offshore, please follow the following sequence:

No.	Description	Chk/Verified
01	Clean all parts thoroughly prior to start-up	
02	To unscrew the seal cartridges, first heat parts to 80 degrees to loosen the Locktite 577 used to secure the threads. Use hot water or an air heat gun.	
03	Use a 26mm Hex key to unscrew the seal cartridges.	
04	Inspect all threads and inner core seal surfaces	
05	Remove the Spherical Core Seals from the seal cartridges	
06	Clean and inspect all seal surfaces	
07	Clean threads and remove old loctite carefully.	
08	Install new seals onto the seal cartridges	
09	Apply a small drop of Loctite 577 on seal cartridge threads.	
10	Apply a thin film of oil on the seals	
11	Verify that the seal cartridge threads enters correctly into the Seal Carrier female threads. Use "finger torque" only and verify that the seal cartridges can be rotated to end stop by hand.	
12	Apply 15 Nm to secure	
13	Perform a complete functional testing of the Valve Stab™ System	
14	Pressurise to design pressure and verify no leakages.	

**TECHNICAL DOCUMENT****7. STORAGE AND TRANSPORT****7.1. STORAGE****7.1.1. Preservation for storage**

No.	Description	Chk/Verified
01	Visual inspect the Hot Stab for damages and wear.	
02	Ensure correct post dive sequence followed (se above sections)	
03	Apply preservation oil and secure in storage box.	

**7.2. TRANSPORT**

No special precautions are needed for transport. However, the following should be verified:

Correct packing; preferably by use of aluminium transport box

Verify the following

1. Sender Name and Address clearly visible
2. Receiver Name and address clearly visible
3. Inventory list correct filled out